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Anterior skull base trauma during endoscopic sinus surgery for nasal polyposis preferred sites for iatrogenic injuries*

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SUMMARY

Objective: To determine typical locations for traumatic lesions of the anterior skull base during endoscopic sinus surgery. Study Design: In this retrospective study 12 patients were included who had undergone endoscopic sinus surgery for nasal polyposis and were referred to the author for revision surgery after iatrogenic trauma of the anterior skull base during the procedure. Each patient had been operated by a different surgeon, all of the physicians being in an advanced stage of their surgical career and being board certified otolaryngologists.
Results: During endoscopically controlled revision surgery, all lesions could be detected, 10 of them being located in the ethmoid roof, while one injury had occurred in the lateral lamella of the cribriform plate and another one in the olfactory groove between the medial turbinate and the nasal septum. Conclusion: In contrast to reports in the literature, the preferred site for anterior skull base injuries during endoscopic sinus surgery in our group was not the lateral lamella of the cribriform plate, but the anterior part of the ethmoid roof, just behind the frontal recess. Apparently the course of the ethmoid roof might be misinterpreted during sinus surgery even by surgeons who are familiar with the operative technique.

Key words: endoscopic sinus surgery, iatrogenic trauma, nasal polyposis, paranasal sinuses

INTRODUCTION

Endonasal sinus surgery (ESS) is the operative treatment of choice in nasal polyposis to date. The technique was introduced in the mid 80's and has gained worldwide acceptance during the last 15 years, thus replacing other, more radical surgical procedures which have been used for the treatment of inflammatory paranasal sinus disease in the past. A few years after the introduction of ESS, several complications of this procedure were reported (Danielsen A, 1992; Levine SB et al., 1991; Maniglia AJ, 1991; Rice DH, 1989; Salman SD, 1991; Stankiewicz JA, 1987; Stankiewicz JA, 1989; Vleming et al., 1992). Some authors attributed these complications to their own limited experience and published their individual learning curve (Stankiewicz JA, 1987; Stankiewicz JA, 1989). More recent contributions, describing complications of ESS in a residency training program also hold the inexperience of the surgeon responsible for the occurrence of intraoperative injuries (Kinsella JB et al., 1995). Besides comparatively minor sequelae (postoperative bleeding, synechiae), there are other, more severe and sometimes life-threatening complications like perforation of the anterior skull base, dura lesions and - sometimes - injuries to the frontal lobe, or to the orbit, optical nerve and internal carotid artery. In nasal polyposis, the probability to jeopardize one of these structures might be increased, which is mainly due to bleeding episodes during surgery resulting in a reduced visual field. The purpose of the present paper was to evaluate whether or not typical sites for iatrogenic lesions of the anterior skull base exist during ESS.

MATERIALS AND METHODS

This retrospective study was performed in 12 patients who were referred to the author for revision surgery of anterior skull base injuries during ESS for nasal polyposis between May 1994 and May 1999. Each patient had been operated by a different surgeon; the physicians were all board certified otolaryngologists; all of them had performed at least 50 ESS-procedures for either chronic sinusitis or nasal polyposis.

PATIENT HISTORIES AND RESULTS

In only half of the patients, the injury to the anterior skull base was realized during the initial operation, and the patients were referred immediately after surgery. In the remaining six

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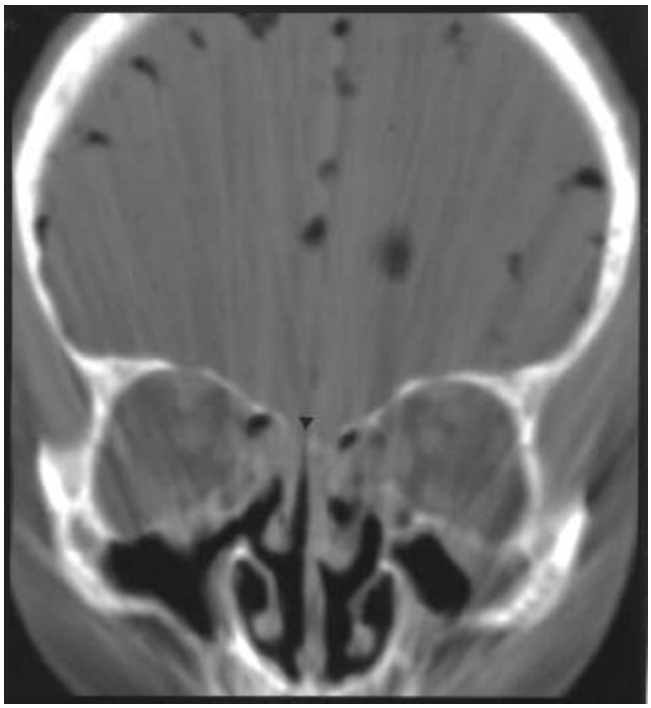

Figure 1. The postoperative CT-scan shows a bony defect in the olfactory groove between medial turbinate and nasal septum (arrowhead).

patients, the surgeons did not notice the injury during the operation. Four of these patients complained of increasing headache for a few days after surgery, which did not disappear after removal of nasal packings; another one developed severe headache after sneezing three days postoperatively. The sixth patient complained of severe headache on the first day after surgery. Liquorrhea was observed endoscopically in two patients prior to revision surgery. CT scans were performed on all patients and revealed bony lesions in three different sites of the anterior skull base (Figures 1-3). Revision surgery was performed in all patients in general anesthesia under endoscopic guidance (Mattox DE and Kennedy DW, 1990). In ten patients, the bony lesion was located in the ethmoid roof, slightly (app. 0,5-1 cm) behind the frontal recess (Figure 2b). The anterior ethmoid artery was not jeopardized in any of these cases. In one patient, the lesion was located at the lateral lamella of the cribriform plate (Figure 3) and in another patient, the injury occurred in the right olfactory groove between the medial turbinate and nasal septum (Figure 1). For closure of all lesions we used one layer of autologous fascia lata which was covered with turbinate mucosa and fixed with fibrin glue. The grafts were kept in place with sinus packs for 3 days. The patients were released from the hospital between 5 and 7 days after revision surgery. Up to now, there were no signs of CSF-leakage or other complications observed in any of these patients.

DISCUSSION

ESS is the treatment of choice in the majority of chronic inflammatory diseases of the paranasal sinuses. Especially in nasal polyposis, the surgeon might be confronted with severe bleeding episodes which can significantly reduce the visual field and may lead to consecutive complications, due to the close relationship between paranasal sinuses and different vitally important structures. Following the increasing popularity of endoscopic sinus procedures over the last 15 years, several reports on iatrogenic complications appeared in the literature in recent years (Danielsen A, 1992; Levine SB et al., 1991; Maniglia AJ, 1991; Rice DH, 1989; Salman SD, 1991; Stankiewicz JA, 1987; Stankiewicz JA, 1989; Vleming et al., 1992). While injuries of the optic nerve or carotid artery might only occur in patients requiring a complete ethmoidectomy or sphenoidectomy, the anterior skull base can be involved in almost every patient undergoing ESS. According to the literature, traumatic lesions of the anterior skull base predominantly occur in the medial parts of the ethmoid roof, which corresponds to the lateral lamella of the cribriform plate (Stammberger H, 1993). This is mainly due to the fact that this region is the thinnest and therefore least resistant part of the anterior skull base (Kainz J and Stammberger H, 1989). In our study, the preferred site for iatrogenic injuries, however, was the ethmoid roof, just behind the

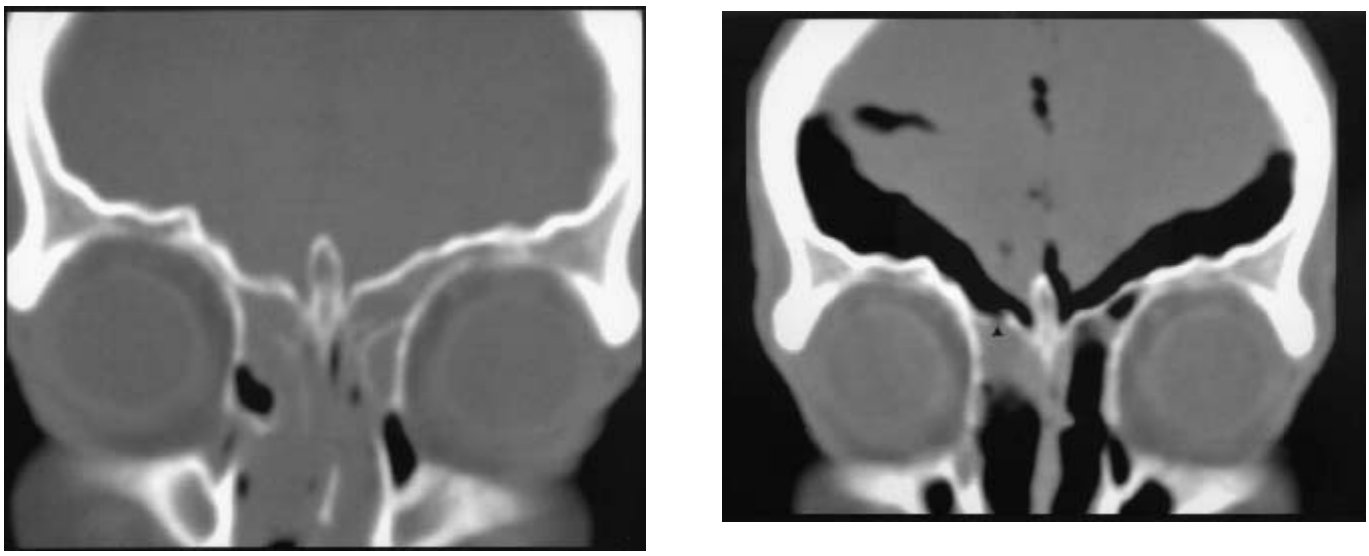

Figure 2. The preoperative CT-scan (a) shows an almost complete opacification of the ethmoid labyrinth and nasal cavities due to extensive polyposis. The ethmoid roof is intact. In the postoperative scan (b) we see a pneumocephalon and a bony lesion of the ethmoid roof (arrowhead).

frontal recess. Even though the bone is thicker in this region, the course of the ethmoid roof is often misinterpreted. Sometimes it is difficult for the surgeon to determine whether he is still in the ethmoid labyrinth or already working on the base of the skull. The patients position during the operation can also influence the probability of injury to the skull base. Once the upper parts of the patients body are in an elevated position, it is easier for the surgeon to work parallel to the skull base. In contrast, if the patient is positioned horizontally on the operation table, the surgeon often works in a steep angle towards the base of skull, thus increasing the probability to injure this delicate structure.

Surgery on nasal polyposis bears several problems, one of them being an increased bleeding probability. This condition reduces the visual field of the surgeon and raises the chance to injure vitally important structures. Another problem of nasal polyposis is the tendency for recurrent disease. Depending on the surgical procedure performed on patients with recurrent polyposis, the succeeding surgeon may be confronted with extensive scarring and the impossibility to identify surgical landmarks. To address these problems in the surgical management of nasal polyposis, Setliff and Parsons (1994) have introduced a new instrumentarium for functional endoscopic sinus surgery. The system ensures meticulous cutting of tissue instead of tearing; an integrated suction system enables the surgeon to operate in a near-bloodless field, thus providing an unimpaired vision for a safe approach to the paranasal sinuses. Our experiences with this instrumentarium have confirmed its usefulness, especially in the operative management of nasal polyposis in terms of less traumatic surgery and better visual field, thus implying fewer complications during ESS (Grevers G, 1995). We have been using micro debrider ('shaver')-systems in the treatment of primary nasal polyposis as well as recurrent disease in more than 500 patients over the last 5 years and did not see any complications.

Another advancement in increasing the safety of ESS was the development of computer-aided surgical navigation systems (CAS). CAS-systems today have gained a degree of accuracy which makes them not only suitable, but almost necessary, especially for difficult surgical procedures in sinus and anterior skull base surgery (Anon JB, 1998; Caversaccio M et al., 1998; Fried MP et al., 1996; Grevers G et al., 1999; Metson et al., 1998; Schlöndorff G et al., 1987; Schlöndorff G et al., 1989). Especially in difficult cases of revision surgery and recurrent polyposis, the use of CAS-systems will be required in the future to increase the safety measures for endonasal sinus surgery.

CONCLUDING REMARKS

The complications reported in this paper should remind anyone dealing with ESS to undertake a thorough anatomical training on cadaver specimen under endoscopic guidance before performing surgery on a patient. Beginners should start with chronic sinusitis patients before doing endonasal polyposis, to get familiar with the anatomy under life conditions. The use of a shaver-system or CAS, the latter predominately in revision cases, is helpful and does increase safety during the procedure; both tools, however, are not suitable to substitute adequate anatomical and surgical training.

Figure 3. CT-scan after ESS for nasal polyposis with doylesplints still in place. The defect is located at the lateral lamella of the cribriform plate (arrowheads).

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